PROTECT

Puerto Rico Testsite for Exploring Contamination Threats

Building Partnerships to Increase Community Participation to Assess Environmental and Social Determinants of Maternal and Child Health

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Hazardous Waste and Contaminated Sites Pose a Unique Set of Challenges

Complex

Persistent

Multifactorial

and are compounded by the different needs and goals of involved parties. **In addition to cleanup, delay in progress can be attributed to the:**

Lack of collaboration

Information transfer to the end-user

Partnership building among academia, industry, government and the affected community

Public participation

Holistic solutions that incorporate all affected parties are needed.

Environmental Justice is Not Being Achieved at Many Contaminated Sites Across the U.S.

- Communities of color and low income bear a disproportionate burden in the location of treatment storage and disposal facilities and Toxic Release Inventory facilities

Inequitable distribution of risk

Components of selected participatory-based approaches to promote community engagement

M.D. Ramirez-Andreotta et al. (2014). Science of the Total Environment 497–498 (2014) 651

Public Participation in Scientific Research[a]	Popular Epidemiology[b]	Community-based participatory Research[c]	Community Capacity[d]	Community Science[e]	Popular Education[f]
Participatory process where community or public choose or define question(s) for study	Public participation in lay observations of health effects and pollutants	Involves public participation in systems development through a cyclical and iterative process	Participation	Participatory	People should be active participants, rather than passive recipients in their learning process
Gather information and resources	Hypothesizing connections	Builds on strengths and resources within the community	Leadership	Values-linked	Create an atmosphere of trust so that people can share ideas and experiences
Develop explanations (hypotheses)	Creating a common perspective	Facilitates collaborative, equitable involvement of all partners in all phases of the research	Skills	Scientific	Start with what people already know or do.
Design data collection methodologies	Looking for answers from government and science	Integrates knowledge and intervention for mutual benefit of all partners	Resources	Utilization-technology transfer approach	The knowledge gained through life experiences is as important as the knowledge gained through formal education
Collect samples and/or record data	Organizing a community group	Promotes a co-learning and empowering process that attends to social inequalities	Social and organizational networks	Systems-Oriented	Education should progress from action to reflection to action (cycle of praxis)
Analyze samples	Official studies are conducted by experts	Recognizes community as an unit of identity	Sense of community	Contextual - aspects of a community	Knowledge is constructed in the interaction between people
Analyze data	Activists bring in their own experts	Addresses health from both positive and ecological perspectives	Understanding of community history	Longitudinal Research and Longer Timelines	Equality between the "teacher" and "student" and democratic decision making

What is Engagement?

Models of Community Involvement

Community Outreach

- Information dissemination, typically one-way

Community Engaged Research

- Input from community, two way conversation, typically community-academic partnerships

Community-based Participatory Research

- Emphasis on participation and influence of nonacademic researchers in the process of creating knowledge

What is Engagement?

Models of Public Participation in Scientific Research

Contributory	Collaborative	Co-Created
• Designed by scientists and members of the public primarily contribute data	• designed by scientists, members of the public contribute data but also may help to refine project design, analyze data, or disseminate findings	• Designed by scientists and members of the public at least some of the public participants are actively involved in most or all steps of the scientific process

Citation: Bonney, R., Ballard, H., Jordan, R., McCallie, E., Phillips, T., Shirk, J., and Wilderman, C. C. 2009. Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education. A CAISE Inquiry Group Report. Washington, D.C.: Center for Advancement of Informal Science Education (CAISE).

Community-based participatory research model = co-created citizen science project

- Participants to be more fully included in the research process,
- Offer lay perspectives and information,
- Capacity-building for participants
- Lay the groundwork for additional participatory research proposals

Examples From

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The Dewey-Humboldt, Arizona Garden Project

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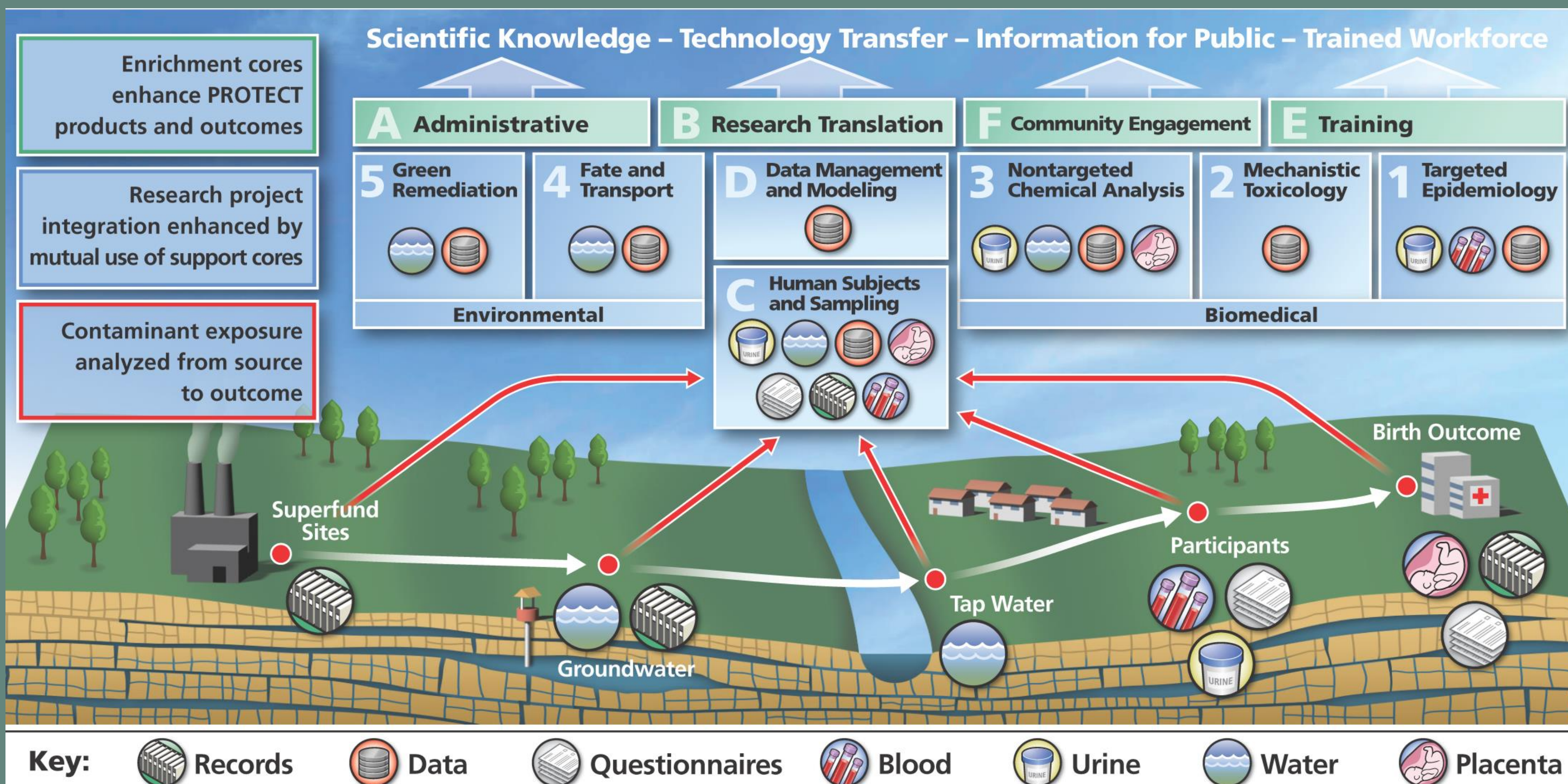

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The Dewey-Humboldt, Arizona Garden Project

Characterize the uptake of arsenic by homegrown vegetables near Superfund Site via controlled greenhouse study in parallel with the co-created citizen science program.

Use the concentrations of arsenic measured in water, soils and vegetable samples in conjunction with reported US intake rates to estimate arsenic exposure and characterize the potential risk

Reporting back results and communicating risk

Israel et al., 1998; Pandya, 2012; Ramirez-Andreotta et al., 2014; Brody et al., 2014)

Activities

- Meet with multiple community members early on in the process of developing program
- Work together to develop scientific questions that support community goals

Origin of Research Question and Need

march of dimes®

working together for stronger, healthier babies

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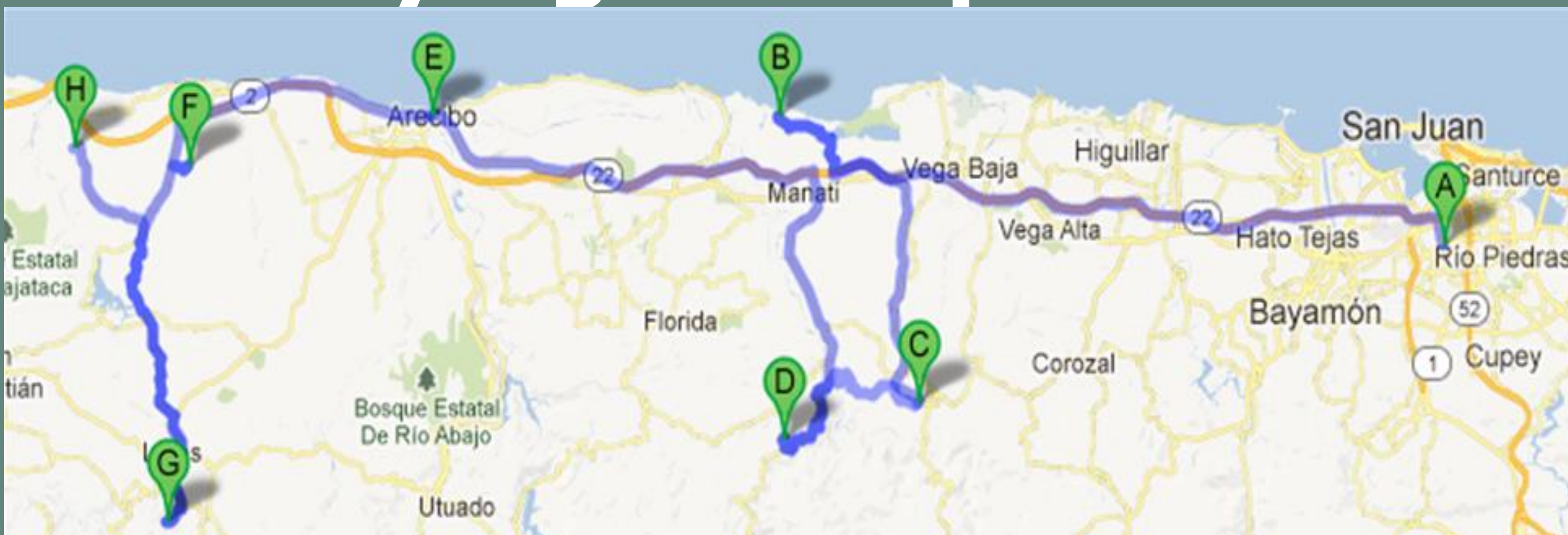
Puerto Rico Testsite for Exploring Contamination Threats

Identifying Champions

- Collaboration with local stakeholders
  - March of Dimes
  - Puerto Rico Taskforce for Prematurity
  - Environmental Protection Agency (EPA)
- Local Community Health Centers
- PRYMED staff has been crucial in the successful implementation
- Local environmental advocate groups
  - Citizens of the Karst, COTICAM…
- **Past participants are now assisting with study and are advocates**


Identifying Champions



- Federally Qualified Health Centers (Local Community Clinics): Morovis (C), Ciales (D), Camuy (F), Lares, (G), Quebradillas (H)
- Private Practice OB/GYN - Delta OB/GYN (B)
- Affiliated Hospitals: UPR District Hospital (A), Manatí Medical Center (B), Cayetano Coll y Toste (E)

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The Dewey-Humboldt, Arizona Garden Project

Align research and education with community priorities

- Identified champions
- Build Partnerships in the Public Sphere
- Create a Transdisciplinary Team

Activities

Plan for co-management of the project

- Community members participating in advisory boards
- Hosting regular informal interactions between scientists and local community members
- Providing advanced scientific training to community members
- Develop MOU's with Community Health Centers and local agencies and organizations

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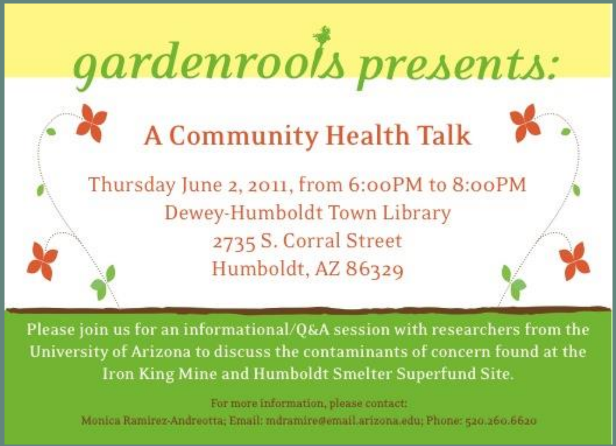
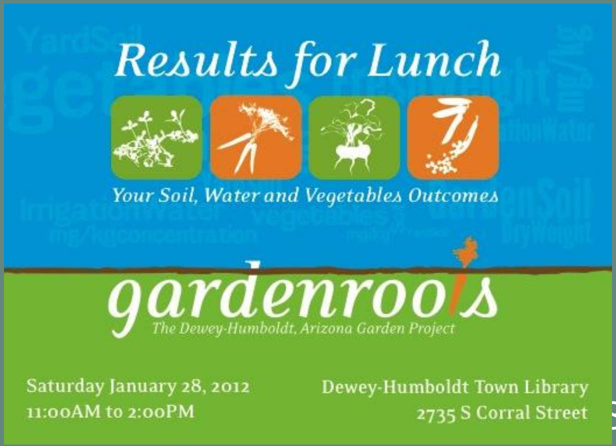
The Dewey-Humboldt, Arizona Garden Project

Plan for co-management of the project

- Ongoing communication and informal science educational opportunities throughout the project to manage community expectation and involvement





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Plan for co-management of the project

- Organize Community Participatory Action Team
- Recruit and Meet with Collaborators and Advisors Committee
- Training Activities for CBPR Approach
- Develop training and educational materials for participants
- Development of initiatives proposed by participants and Communities

Steps in Scientific Research
Choose or define question(s) for study
Gather information and resources
Develop explanations
Design data collection methodologies
Collect samples and/or record data
Analyze samples
Analyze data
Interpret data and draw conclusions
Disseminate conclusions/ Translate results into action
Discuss results and ask new questions

Steps in Scientific Research

Choose or define question(s) for study

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Interpret data and draw conclusions

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Discuss results and ask new questions

- **Data Validation – QA/QC**
  - Methods and mathematical equations used to interpret the data was described.
  - Participants recalculated their potential exposure and risk and change the variables to suit their behavior

- Participants worked together to identify/notify households who were on the public water supply.

- Concentrations of arsenic and heavy metals in chicken eggs? Correlation between the exposure pathways and the concentrations observed in eggs.
- Do cinder blocks in a raised garden bed contributed arsenic to their soil?
- Quality of local farm vegetables?

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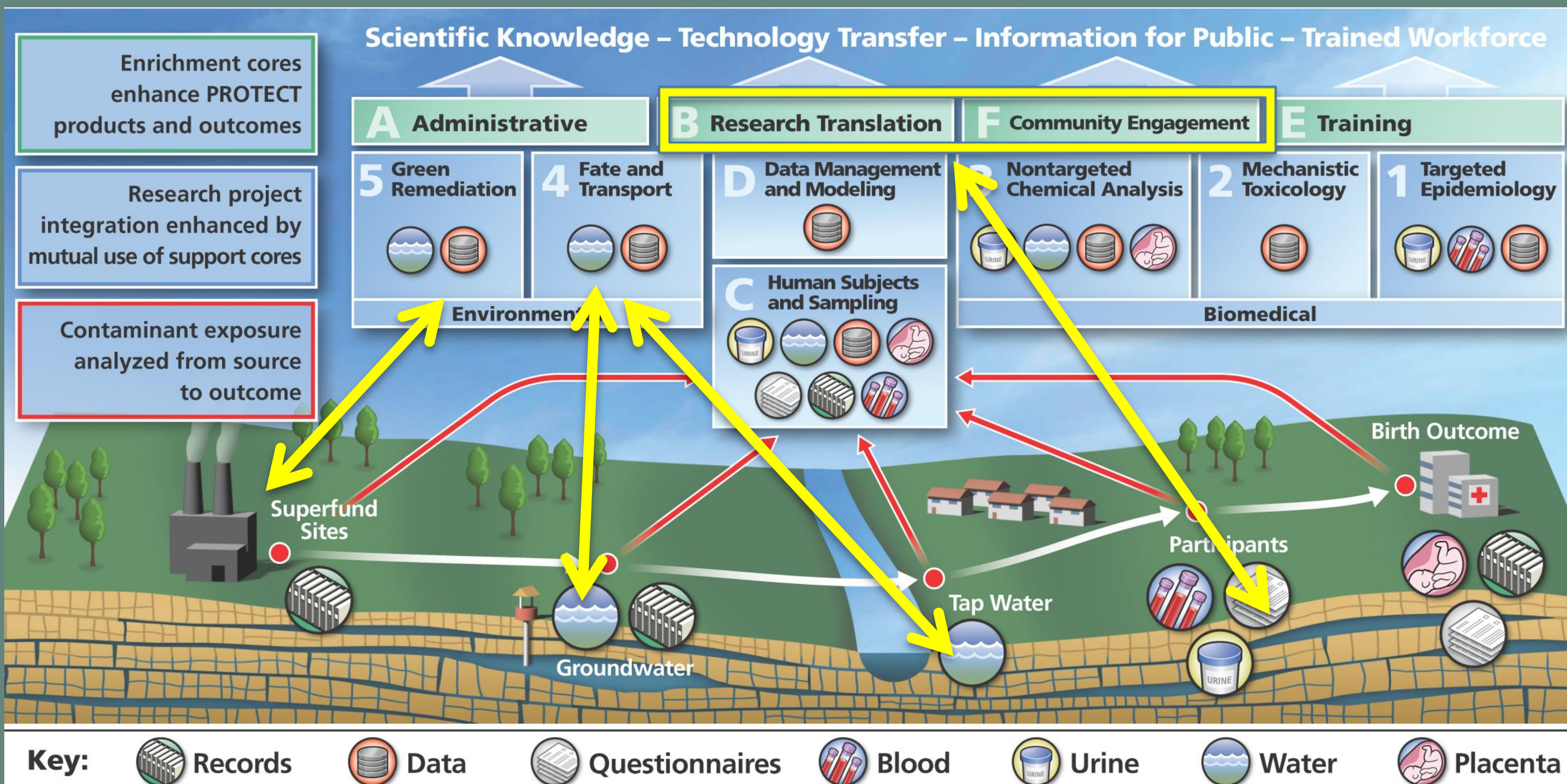


Activity

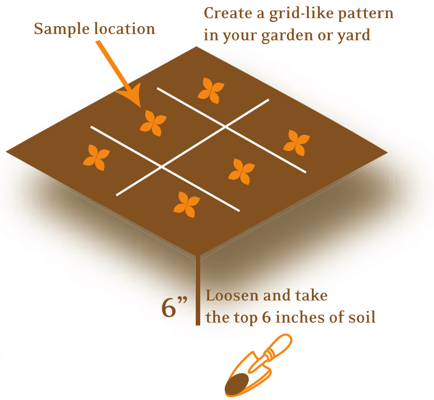
Incorporate multiple forms of knowledge

- Value traditional knowledge, historical accounts, and participant observations
- Equality and fostering an environment of co-learning

- Interviews with Key informant, Focus Groups, Document Analysis
- Analyze Feedback Information from Assessment for development of report-back materials
- Develop report-back materials
- Continuous evaluation of communication system and report back

1. Collecting Soil Samples from your Garden

1. Select (mark) six locations (spots) in a roughly grid-like pattern to sample in your garden.
2. Using a the hand trowel provided, loosen the top 6" of each of the six soil spots.
3. At each location take one full scoop of soil and place it into a 5-gallon bucket labeled A.
4. Mix the six soil samples thoroughly inside the bucket. This process is called sample bulking.



3. Collecting Water Samples (preferably in the late afternoon)

Using the water source you use to irrigate your garden:

1. Turn on the water (hose) and allow to flow for 2-3 minutes. During this you may fill out the labels of the bottles with all the information requested.
2. Slow the flow to a small trickle and carefully fill each bottle until water overflows.
3. Once full quickly cap each bottle and seal.
4. Place the 3 bottles in a 1-gallon Ziploc bag, seal and store in a refrigerator (do NOT freeze water samples) until you are ready to drop off at the Yavapai County Extension Office.

4. Collecting Vegetable Samples

General guidance was given and participants decided where to select soil sample and which vegetables to analysis vegetables

7. Soil should now be air-dried or kept

Tub 2 filled with provided distilled water and 1 tablespoon of bleach. Dip

Participants began to ask new scientific questions

did above for you garden soil, but now for your yard soil. Complete steps 1-7 above, note for step 3 now use the 5-gallon bucket labeled B.

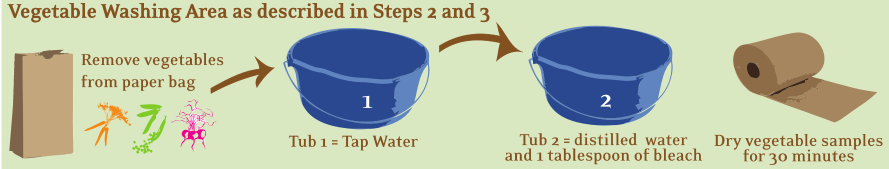
Drop-Off Checklist:
1) Garden soil sample in paper bag and then 1-gallon Ziploc bag
2) Yard soil sample in paper bag and then 1-gallon Ziploc bag
3) 3 water sample bottles in a 1-gallon Ziploc bag
4) Vegetable samples individually bagged, and then in a 1-gallon Ziploc bag

Drop off all samples at the UA Yavapai Cooperative Extension Office, 840 Rodeo Dr, Bldg C, Prescott, AZ 86305

pre-labeled, and remove all air from bag before sealing. Then place all your bagged vegetable samples in a 1-gallon Ziploc bag.

5. Promptly place the bag in the refrigerator till you are ready to drop off at the Yavapai County Extension Office.

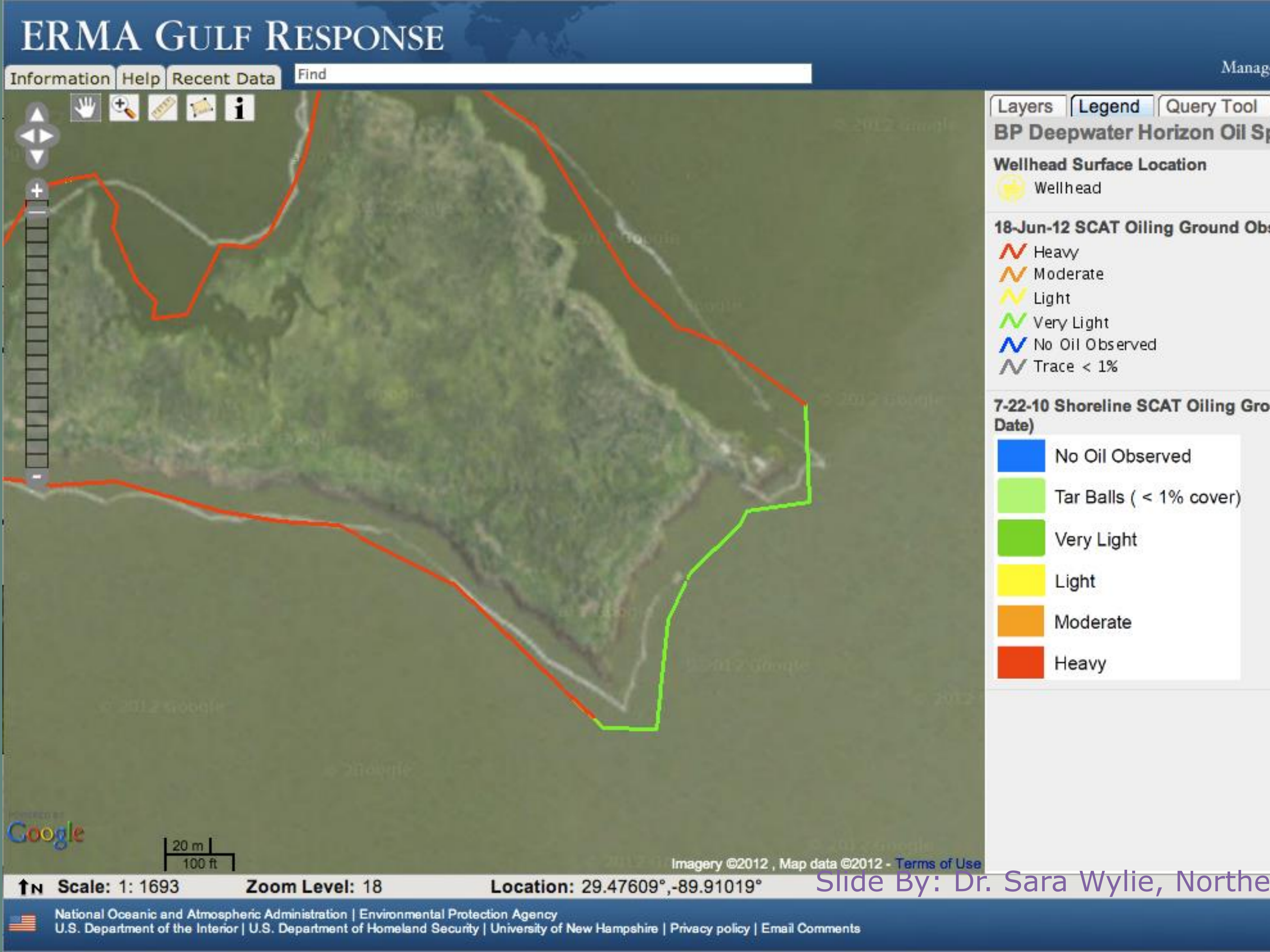
Vegetable Washing Area as described in Steps 2 and 3



- ***Citizen Science efforts around environmental health is changing the tools for environmental research reducing their cost, increasing their accessibility and producing different types of data.***

Colleague – Dr. Sara Wylie, Northeastern University

– Co-founder of Public Lab for Open Technology and Science



Slide By: Dr. Sara Wylie, Northe

Grassroot apping Imagery

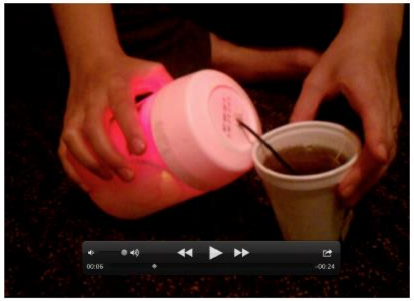
Slide By: Dr. Sara Wylie, Northeastern University

DIY Thermal Imaging: Monitoring Thermal Pollution

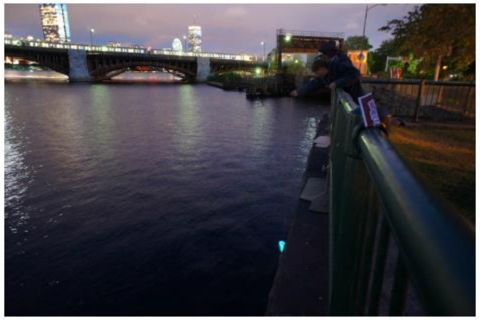
Slide By: Dr. Sara Wylie
Northeastern Universit

The Thermal Fishing Bob is a Citizen Science tool that shows water temperature with colors of light. As shown here, a hot cup of tea turns the fishing bob red (right). These images show our first field test of the Thermal Fishing Bob mapping a thermal plume from a power plant on the Charles River with the Boston Museum of Science.

Major components of a Thermal Fishing Bob: 10K thermistor, Arduino Uno and 3 color LED

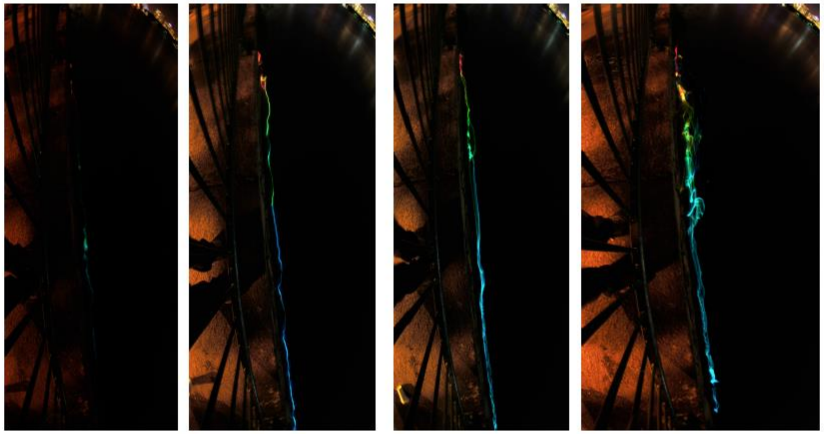


Getting bobs ready for a field test



Dropping bobs into the Charles River

Temperature changes detected by the thermal fishing bob are capture with long exposure photos.



Trial 1 Trial 2 Trial 3 (2 Bobs) Trial 4 (2 Bobs)

Combining all the test results.

Activity

Disseminate results broadly

- Report back initiatives
- Co-design communication methods
- Provide data to general public

Increasing Awareness

- PROTECT in the Media
  - Puerto Rico and United States
    - Local Newspapers
    - Television
- Collaboration with University of Sacred Heart Puerto Rico
  - Protect documentary – 36 Semanas
    - Contamination in Puerto Rico and PROTECT approach to discover potential exposure to contaminants during pregnancy

Community report-back

- Adds context and opportunity for discussion

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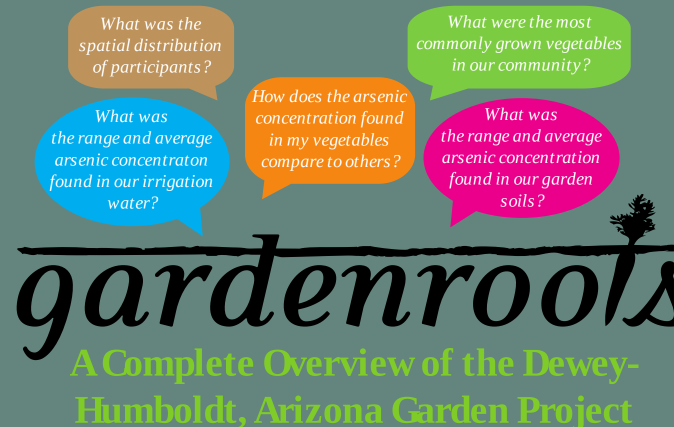

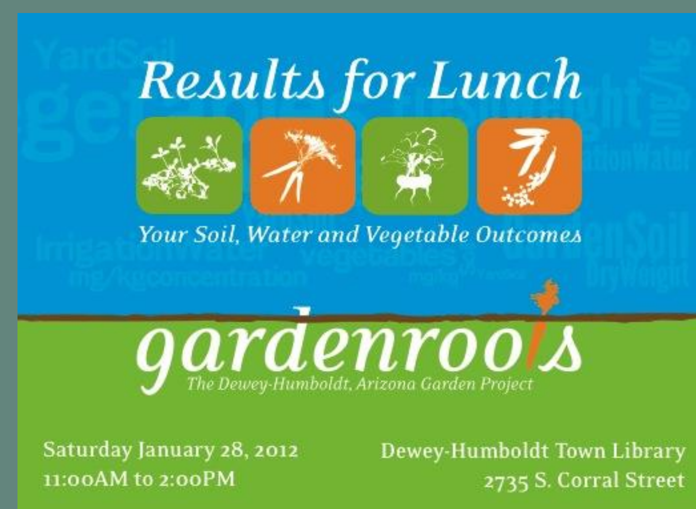

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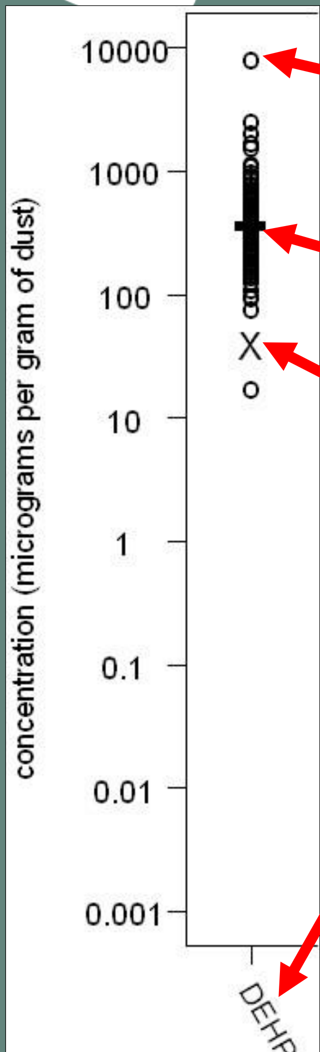
How to report data back

Typical participant questions about personal exposure results, Brody et al., 2007	Information provided to *Gardenroots* participants (Ramirez-Andreotta et al., 2015)
Description	
What did you find? What did you look for?	Concentration of arsenic (contaminant of concern) and 19 other elements of potential interest
How much?	Concentrations for all 20 elements were presented in a chart for all their vegetables, soil and water samples analyzed.
Analysis/Comparison	
Is that high?	Arsenic concentrations observed in vegetables from the USDFA Market Basket Study were used for comparison. Regional soil screening levels and the maximum contaminant levels in water was provided.
Is that safe?	Chart exhibiting how much of the vegetable can be consumed from their garden at various excess target risks
What should I focus on?	Participants were able to compare the risk posed from each exposure route (water, soil, vegetable) and the arsenic concentration in each vegetable to then decide where to focus mitigation efforts
Where did the chemical come from?	Participants identified their gardens as potential sources of arsenic and initially asked the research question
Recommendation	
What can/should I do?	Exposure reduction/precautionary strategies were provided such as: recommended gardening practices handouts were generated to guide gardeners, "Arizona Know Your Water" and "Arizona Know Your Well Water" guides*

Report Back Example



Each ∘ represents one other home in the study

– is the sample from your home

X is the EPA Guideline

Chemical abbreviation (di(2-ethylhexyl) phthalate)

DEHP common uses: Plastics, inks, insect repellant, cosmetics, rubbing alcohol, liquid soap, detergents, lacquers, munitions, industrial lubricant.

Brody et al. AJPH, 2007

What can I do?

Polluters (refinery, ships)	Products *hard to avoid* (flame retardant)	Products *individual choices* (indoor pesticides)
Collective Action	**Collective Action**	**Individual Action**
Organize Participate Vote!	Chemicals policies Consumer campaigns Vote!	Product choices IPM

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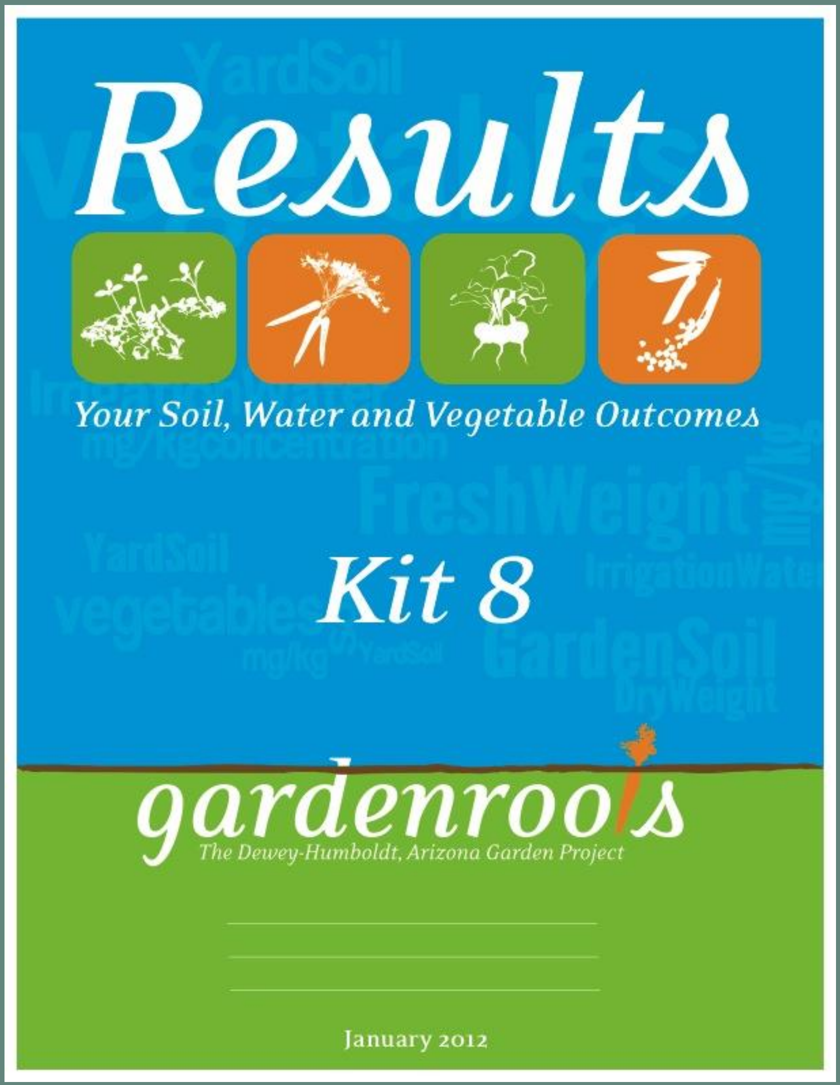
Reporting All Results and Potential Risks



- The metal(loid) concentrations in their soil, water and vegetables
- How much they can eat at various target risks
- Estimated risks associated with soil, water and vegetables → allowed participant to compare risks posed by the different exposure routes
- Nutritional content in vegetables

- Elemental information
- Naturally occurring levels
- Brief explanation

Soils

Arsenic is a solid substance (metalloid) naturally existing in the Earth's crust and in crushed rock. Arsenic exposure is natural but can be increased as a result of human activities.

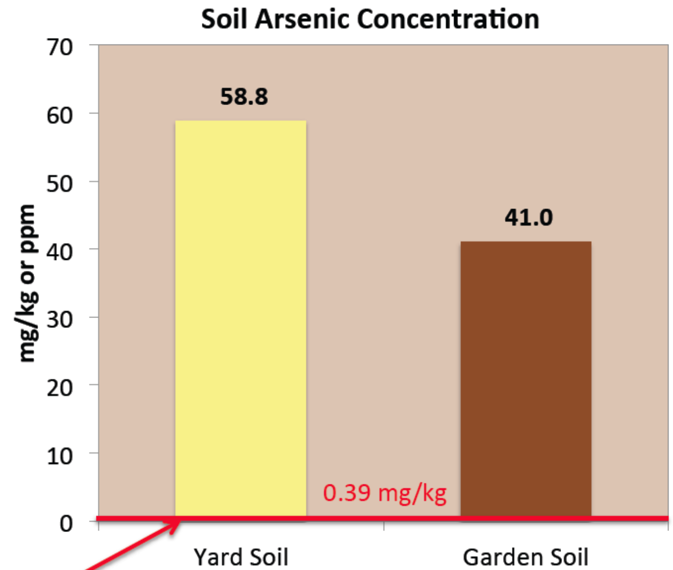
The concentration of arsenic in soil varies widely, generally ranging from about 1 to 40 mg/kg with an average level of 5 mg/kg. In general, Yavapai County has naturally occurring arsenic due to the geology in the area, which can lead to higher concentrations in soil and water.

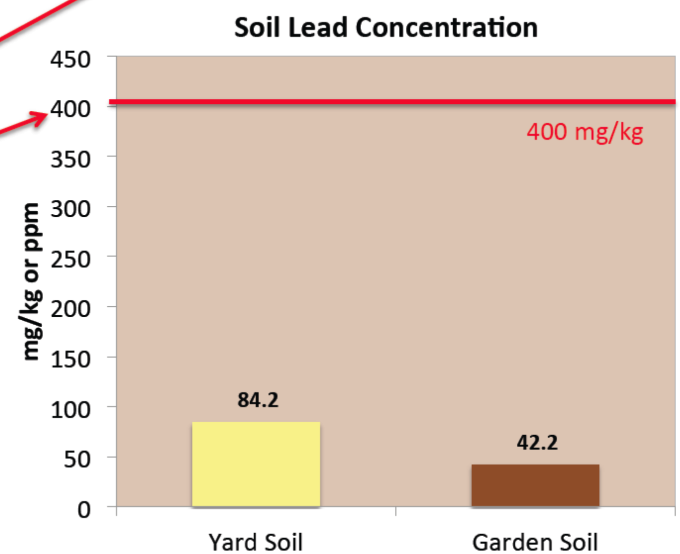
U.S. EPA Residential Regional Screening Levels

Lead is a metal in the earth's crust that is normally found with other metals such as zinc, silver, and copper.

All the soils in the world contain small amounts of naturally occurring lead with an average of 10 mg/kg.

The graphs below show the concentrations of arsenic and lead in the yard and garden soil samples you provided.





Contaminants of concern and reference values visually displayed

All concentrations and reference values

Element Concentrations in your Yard and Garden Soil Samples

Element	Yard Soil	Garden Soil	U.S. EPA Residential Regional Screening Level (mg/kg or ppm)
Arsenic	58.8	41.0	0 .39
Barium	373	346	15,000
Beryllium	0.634	0.879	160
Cadmium	1.34	0.862	70 (Diet)
Calcium	11,500	7,490	No screening level
Chromium	40.1	39.2	No screening level for total chromium
Cobalt	17.6	20.2	23
Copper	174	119	3,100
Iron	47,500	42,400	55,000
Lead	84.2	42.2	400
Magnesium	4,810	5,370	No screening level
Manganese	2,690	2,680	1800 (Non-diet)
Mercury	0.0692	0.0374	10
Molybdenum	0.950	0.738	390
Nickel	30.3	33.1	1500 (Soluble salts)
Phosphorous	1,480	1,420	No screening level
Potassium	4,210	4,060	No screening level
Selenium	1.83	2.01	390
Sodium	128	156	No screening level
Zinc	336	171	23,000

pH Values in your Yard and Garden Soil Samples

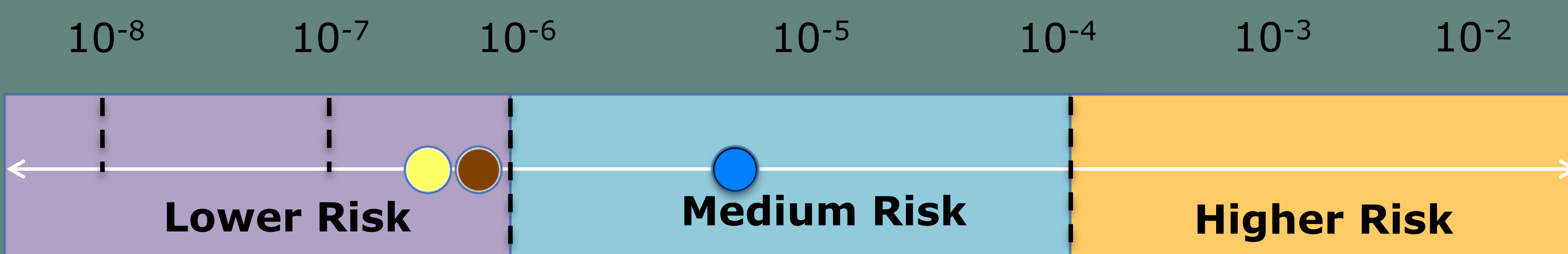
pH	Yard Soil	Garden Soil	USDA Natural Resources Conservation Service - Optimal Range for Crops
	7.63	7.57	6 - 7.5

Risk Characterization for Arsenic: Cancer	Yard Soil	Garden Soil	
Incremental Excess Lifetime Cancer Risk	15 out of 1,000,000	9 out of 1,000,000	Scenario: Accidental soil ingestion while gardening

Risk Characterization for Arsenic: Cancer		
Incremental Excess Lifetime Cancer Risk	5 out of 100,000	Scenario: Drinking 2 liters/day

Legend

- Yard Soil
- Garden Soil
- Irrigation Water



Activity

Cultural model of risk communication

- Results and risk tailored to the community's need so they may make more informed decisions
- Steps the community can take to assert some level of control and reduce their exposure to potential environmental hazards
- Involve affected groups in judgments of acceptable and unacceptable risks

Compared *Gardenroots* to a nationwide study for reference

gardenroots

The Dewey-Humboldt, Arizona Garden Project

U.S. Food and Drug Administration

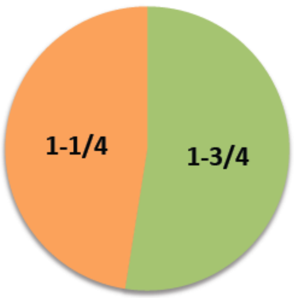
Protecting and Promoting *Your* Health

Total Diet Study – Market Baskets

Vegetables

Using the USDA recommendation, and the measured arsenic concentration from your vegetables, the pie chart below shows how much you can safely eat from your garden at a target risk of 1/100,000.

Kale



You can safely eat up to 1-3/4 cups of Kale weekly from your garden; the rest should be store bought (USDA recommends 3 cups/week of "Raw Leafy Green Vegetables").

Concentrations of All Measured Elements (Fresh Weight, mg-element/kg-vegetable)	
Element	Kale
Arsenic	0.0371
Barium	0.941
Beryllium	≤LOD
Cadmium	0.00861
Calcium	2,540
Chromium	0.0129
Cobalt	≤LOD
Copper	0.426
Iron	6.07
Lead	0.00799
Magnesium	350
Manganese	2.70
Molybdenum	0.00210
Mercury	0.294
Nickel	0.0127
Phosphorous	569
Potassium	5,300
Selenium	0.0357
Sodium	249
Zinc	4.14

How much to eat from garden?

All raw values

But wait!

protect

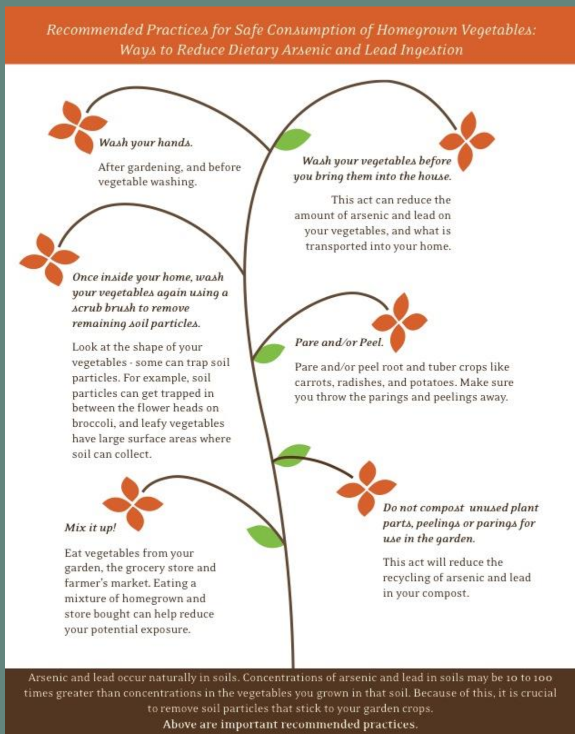
Allowed them to decide for themselves

"It is your choice to decide what target risk you want to use to make decisions about how many cups per week to consume from your garden."

Amount You Can Eat from Your Garden Based on a Cancer Target Risk

Location	Target Risk 1/1,000,000	Target Risk 1/100,000	Target Risk 1/10,000	USDA Recommended Amount (cups/week)
Onion				
Your Garden	3/4	7	70	4 cups/week total of "Other Vegetables"
Lettuce				
Your Garden	1/2	5	50	3 cups/week total of "Raw Leafy Dark Green Vegetables"
Tomato				
Your Garden	1-1/2	15	150	5 cups/week of "red and orange vegetables"

Present Solutions and Recommendations



Recommended Practices for Safe Consumption of Homegrown Vegetables: Ways to Reduce Dietary Arsenic and Lead Ingestion

Wash your hands.
After gardening, and before vegetable washing.

Wash your vegetables before you bring them into the house.
This act can reduce the amount of arsenic and lead on your vegetables, and what is transported into your home.

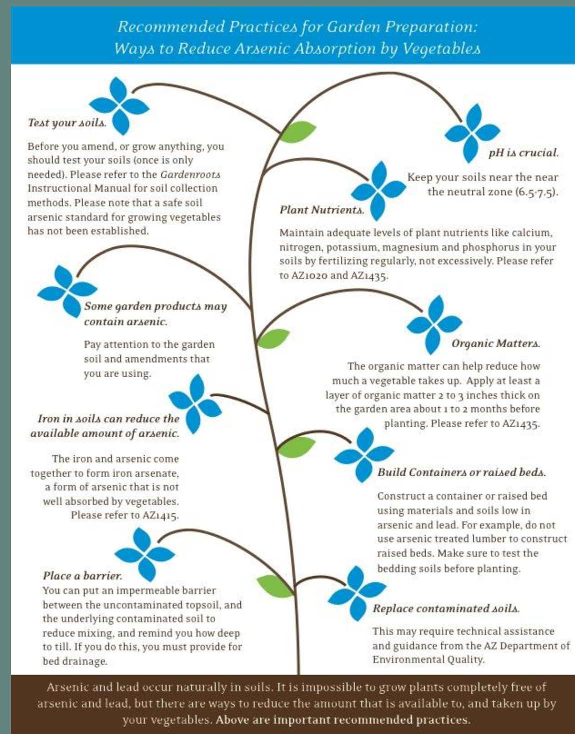
Once inside your home, wash your vegetables again using a scrub brush to remove remaining soil particles.
Look at the shape of your vegetables - some can trap soil particles. For example, soil particles can get trapped in between the flower heads on broccoli, and leafy vegetables have large surface areas where soil can collect.

Pare and/or Peel.
Pare and/or peel root and tuber crops like carrots, radishes, and potatoes. Make sure you throw the parings and peelings away.

Mix it up!
Eat vegetables from your garden, the grocery store and farmer's market. Eating a mixture of homegrown and store bought can help reduce your potential exposure.

Do not compost unused plant parts, peelings or parings for use in the garden.
This act will reduce the recycling of arsenic and lead in your compost.

Arsenic and lead occur naturally in soils. Concentrations of arsenic and lead in soils may be 10 to 100 times greater than concentrations in the vegetables you grown in that soil. Because of this, it is crucial to remove soil particles that stick to your garden crops.
Above are important recommended practices.



Recommended Practices for Garden Preparation: Ways to Reduce Arsenic Absorption by Vegetables

Test your soils.
Before you amend, or grow anything, you should test your soils (once is only needed). Please refer to the *Gardenroots* Instructional Manual for soil collection methods. Please note that a safe soil arsenic standard for growing vegetables has not been established.

pH is crucial.
Keep your soils near the near the neutral zone (6.5-7.5).

Plant Nutrients.
Maintain adequate levels of plant nutrients like calcium, nitrogen, potassium, magnesium and phosphorus in your soils by fertilizing regularly, not excessively. Please refer to AZ1020 and AZ1435.

Some garden products may contain arsenic.
Pay attention to the garden soil and amendments that you are using.

Organic Matters.
The organic matter can help reduce how much a vegetable takes up. Apply at least a layer of organic matter 2 to 3 inches thick on the garden area about 1 to 2 months before planting. Please refer to AZ1435.

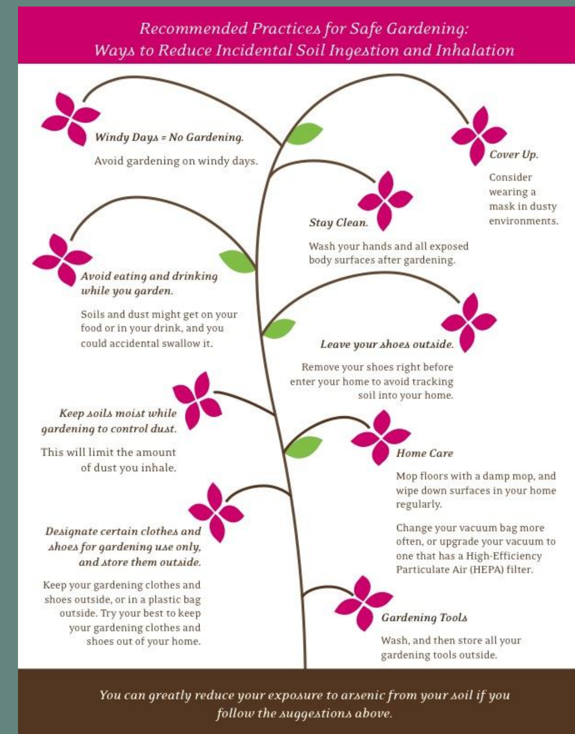
Iron in soils can reduce the available amount of arsenic.
The iron and arsenic come together to form iron arsenate, a form of arsenic that is not well absorbed by vegetables. Please refer to AZ1415.

Build Containers or raised beds.
Construct a container or raised bed using materials and soils low in arsenic and lead. For example, do not use arsenic treated lumber to construct raised beds. Make sure to test the bedding soils before planting.

Place a barrier.
You can put an impermeable barrier between the uncontaminated topsoil, and the underlying contaminated soil to reduce mixing, and remind you how deep to till. If you do this, you must provide for bed drainage.

Replace contaminated soils.
This may require technical assistance and guidance from the AZ Department of Environmental Quality.

Arsenic and lead occur naturally in soils. It is impossible to grow plants completely free of arsenic and lead, but there are ways to reduce the amount that is available to, and taken up by your vegetables. Above are important recommended practices.



Recommended Practices for Safe Gardening: Ways to Reduce Incidental Soil Ingestion and Inhalation

Windy Days = No Gardening.
Avoid gardening on windy days.

Cover Up.
Consider wearing a mask in dusty environments.

Stay Clean.
Wash your hands and all exposed body surfaces after gardening.

Avoid eating and drinking while you garden.
Soils and dust might get on your food or in your drink, and you could accidental swallow it.

Leave your shoes outside.
Remove your shoes right before enter your home to avoid tracking soil into your home.

Keep soils moist while gardening to control dust.
This will limit the amount of dust you inhale.

Home Care
Mop floors with a damp mop, and wipe down surfaces in your home regularly.
Change your vacuum bag more often, or upgrade your vacuum to one that has a High-Efficiency Particulate Air (HEPA) filter.

Designate certain clothes and shoes for gardening use only, and store them outside.
Keep your gardening clothes and shoes outside, or in a plastic bag outside. Try your best to keep your gardening clothes and shoes out of your home.

Gardening Tools
Wash, and then store all your gardening tools outside.

You can greatly reduce your exposure to arsenic from your soil if you follow the suggestions above.

Safe Consumption of Homegrown Vegetables

Garden Preparation

Safe Gardening

www.neu.edu/protect

Community engagement Core Goals

- Report data back to mothers
- Provide resources for early childhood development
- Prevent exposure to contaminants
- Provide information on environmental contamination relevant to health in general

CITIZEN SCIENCE 2015

Conference and Gathering

February 11 & 12
San Jose, California, USA
#CitSci2015

What: Citizen Science is a partnership between everyday people and professional scientists to investigate pressing questions about the world. CitSci2015 invites anyone interested in such collaborations to participate.

Who: People involved in all aspects of citizen science are welcome, including researchers, project leaders, educators, evaluators, designers and makers, volunteers, and more—representing a wide variety of disciplines.

Why: Join people from across the field of citizen science to discuss designing, implementing, sustaining, evaluating, and participating in projects. Share your project innovations and questions.

When: February 11 & 12, 2015

Where: San Jose, California, USA

Want to participate? Whether this is your first conference or just your latest, we invite you to attend, be a presenter, or both!

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- **Story Telling**
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- **Longer Talks (15 min)**
- **Symposia/Panel Discussions**
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Submit your presentation proposal by September 15

Citizen Science 2015 is the inaugural conference and gathering of the newly formed Citizen Science Association (CSA). This event is a pre-conference of the 2015 American Association for the Advancement of Science (AAAS) Annual Meeting.

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Ramirez-Andreotta - Serving on National Planning Committee

PROTECT

Puerto Rico Testsite for Exploring Contamination Threats

How can We Work Together?

- **Presenters: Monica Ramirez-Andreotta (NEU), Carmen Milagros Velez Vega (UPR-MC), Liza Anzalota (UPR-MC)**
- Other colleagues: Phil Brown (NEU), Julia Brody (Silent Spring Institute)